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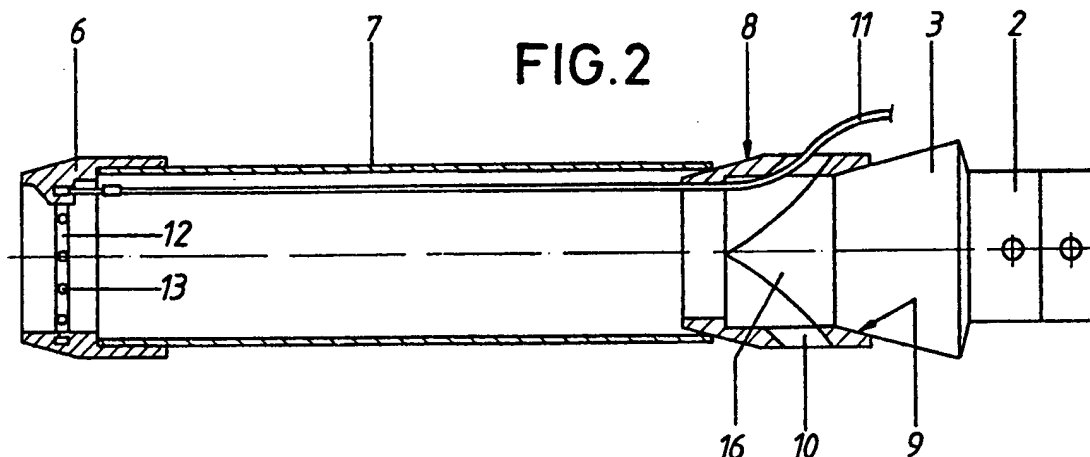
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(54) Apparatus for driving pipes through the ground

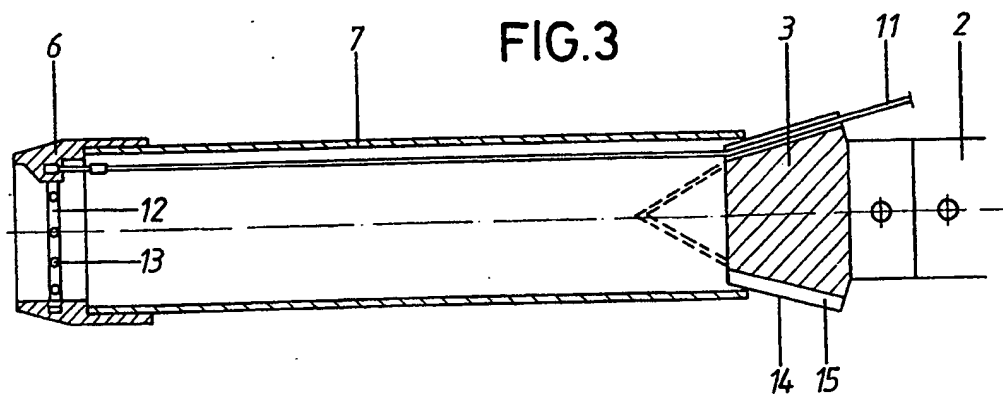
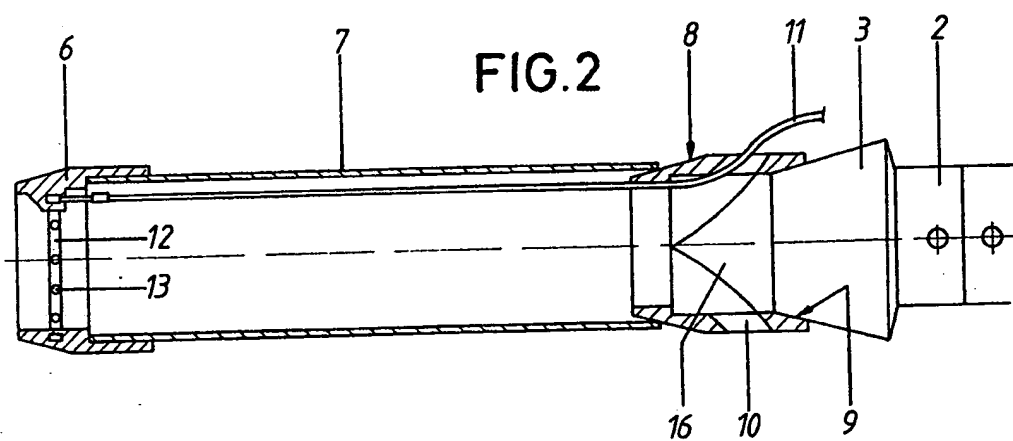
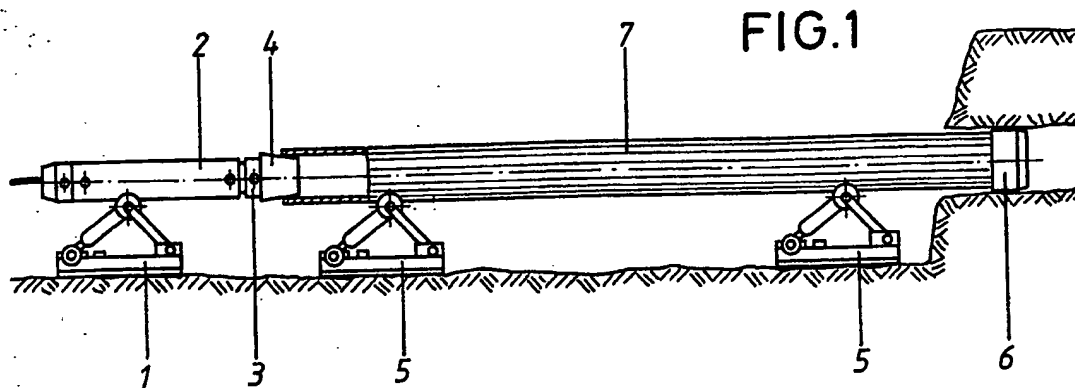
(57) Apparatus for driving an open-ended pipe 7, which has a driving shoe 6 at its leading end, through the ground comprises a driving member 2, 3 to which percussive driving forces are applied by a driving mechanism. Instead of fitting the part 3 of the driving member directly into the rear end of the pipe 7 as is usual an intermediate component 8 is interposed between the pipe and the part 3. The component 8 has soil outlet openings 10 and a deflector 16 to allow soil which enters the pipe 7 through the shoe 6 as driving proceeds to pass through and out of the pipe without stopping the driving. The passage of the soil through the pipe 7 is assisted by water supplied under pressure through a pipe 11 to an annular duct 12 in the shoe 6, whence the water flows inwards through nozzles 13 and then rearwards through the pipe 7 carrying the soil with it.



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## SPECIFICATION

**Apparatus for driving pipes through the ground**

5 This invention relates to apparatus for driving open-ended pipes, for example protective conduits or pipelines, through the ground.

10 The driving of steel or other metal pipes with the assistance of a pipe driving apparatus having a part-conical head which engages directly or through a driving attachment into the rearward end of the pipe which is guided in the direction of driving on bearing supports

15 and which has a driving shoe which fits internally and externally over its forward end, has become increasingly common. Since the pipe being driven is open at the front, that is at the driving shoe, the soil through which the

20 pipe is driven penetrates during driving further and further into the interior of the pipe, while the driving shoe compacts the soil surrounding the pipe and, because the shoe is of a larger diameter than the pipe, the shoe

25 creates a hole through the ground, in which the pipe moves forwards under the impacts of the driving apparatus with comparatively low external wall friction.

30 As the pipe becomes filled with soil over an increasing length as driving advances, the soil friction against the internal wall of the pipe also increases. This is particularly so as the soil in the interior of the pipe becomes progressively more compacted under the influence of the driving blows and under the

35 pressure of the soil entering from the forward end of the pipe. Furthermore, the soil situated inside the pipe is inevitably accelerated forwards together with the pipe in the forward

40 movement of the pipe. Because of these factors additional energy is expended in driving the pipe. What is more, as driving proceeds, the soil must from time to time be removed from the inside of the pipe.

45 A number of techniques are used for removing the soil from the inside of the pipe. Thus, for example, the soil can be removed from the interior of the pipe by means of a driven screw conveyor. It may also be flushed out

50 with high-pressure water, but both these techniques require additional expenditure on apparatus and cause considerable interference with the driving operations. In another technique, which is used when the forward end of the

55 pipe is accessible, as is usually the case, when driving has been completed, for removing the soil from the pipe interior, a pushing disc or piston which seals against the internal surface of the pipe wall is inserted into the

60 leading end of the pipe after driving has been completed, and the interior of the pipe in front of the disc or piston is subjected to compressed air, in order to cause the disc to push the soil out of the interior of the pipe as

65 the disc moves rearwardly through the pipe

under the influence of the compressed air. This technique is also cumbersome and expensive, and can, moreover, only be carried out in short lengths of pipe with low frictional resistance, having regard to the friction of the soil against the pipe internal wall.

70 The object of the present invention is to provide apparatus for driving pipes through the ground which, while involving low expenditure on equipment, makes possible continuous driving and continuous and preferably low-friction removal of soil from the inside of the pipe.

75 To this end, according to this invention, apparatus for driving an open-ended pipe through the ground, which comprises a driving member and means for applying a driving force to the member, is characterised by an intermediate component, which in operation is

80 interposed between the driving member and the rear end of the pipe being driven, the intermediate component having at least one outlet opening, through which soil, which penetrates into the pipe at the leading end thereof as driving proceeds, leaves the inside

85 of the pipe.

90 The intermediate component may be integral with the impact head, that is the driving member, or it may be a separate, preferably tubular, component. The outlet openings can lead from the end face of the intermediate component, which in operation is in the rear end of the pipe, especially where the intermediate component is solid, for example where it

95 is part of the driving member.

100 The outlet openings can also extend radially in the case where the intermediate component is tubular. An intermediate component which has an external part-conical surface which fits in the pipe at one end, an internal part-conical surface which receives the driving member at the other end, and the at least one outlet opening extends radially outwards between the part-conical surfaces, has proved especially successful. To facilitate the removal of the soil from within the pipe a guide device which deflects the soil outwards and in the direction of the outlet openings may be disposed in the interior of the pipe or in the intermediate component, when this is tubular.

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The outlet openings in the intermediate component permit continuous removal of the soil from the pipe interior. In order to facilitate this and in particular to reduce the friction of the soil on the inner wall of the pipe, a liquid distributor may be disposed at the front end of the pipe being driven. Through this distributor, liquid such as water containing lubricant may be added in metered proportions to the soil entering the pipe interior. By means of this water, the consistency of the soil and thus the soil friction inside the pipe can be reduced virtually as much as required, and the removal of the soil through the pipe interior

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130 and through the outlet openings in the inter-

mediate component is considerably facilitated. Depending upon the local conditions, the soil entering into the interior of the pipe may be converted into a pasty or even a liquid state.

- 5 For each individual case, this is solely a question of the quantity of liquid which is added per unit quantity of soil.

The provision of a driving shoe connected to a liquid supply pipe, which in operation passes through the pipe interior or between the pipe wall and the soil and leads to liquid outlet openings in the shoe, has proved particularly successful. The shoe preferably has liquid outlet openings leading radially inwards to the soil inside the pipe from an annular duct in the shoe. In this manner the entire periphery of the plug of soil in the pipe interior can have liquid added to it and thus at least an outer zone which substantially reduces friction can be created in the soil.

Two for examples of apparatus in accordance with the invention will now be described with reference to the accompanying drawings in which:-

- 25 *Figure 1* is a diagrammatical side view of a conventional form of pipe driving apparatus shown driving a pipe;

*Figure 2* is a side view to a larger scale of part of an apparatus in accordance with the invention shown fitted to a pipe; and,

*Figure 3* is a view similar to *Fig. 2*, but of another example of an apparatus in accordance with the invention.

In horizontal driving of a pipe, a driving apparatus 2 guided on a bearing block 1, has a driving member or impact head 3 engaged via an intermediate component 4 with the rearward end of a pipe 7, which is guided on bearing blocks 5 and has at its forward end a driving shoe 6. The intermediate component 4 is, in the example of *Fig. 2*, of tubular construction and possesses, at its forward end, an external part-conical surface 8 engaging in the rearward end of the pipe and an internal part-conical surface 9 receiving the impact head 3. Between the outer surface 8 and the internal surface 9 there are outlet openings 10 for the soil situated in the pipe interior. Through one of the outlet openings 10 there extends a liquid supply pipe 11 leading to the driving shoe 6. The shoe has an annular duct 12, with which the pipe 11 communicates and which possesses outlet openings 13.

Instead of the tubular intermediate component shown in *Fig. 2*, a solid intermediate component which may be part of the impact head 3 of the apparatus 2, may be used. This impact head has, as shown in *Fig. 3*, ribs 14 disposed on its part-conical outer surface in the manner of gear teeth, and outlet ducts 15 are formed between the ribs. These outlet ducts conduct away the soil, which is converted by means of liquid supplied through the pipe 11 to a low-friction mud, outwards

out of the pipe interior. One of the ducts also receives the liquid feed pipe 11.

To enable the soil to be conducted away from the pipe interior more effectively, even without liquid flushing, the intermediate component 4 may contain a guide device 16, as shown in *Fig. 2*. This device deflects the soil from its axial path of movement radially outwards through the outlet openings.

## CLAIMS

1. Apparatus for driving an open-ended pipe through the ground, the apparatus comprising a driving member and means for applying a driving force to the member, characterised by an intermediate component, which in operation is interposed between the driving member and the rear end of the pipe being driven, the intermediate component having at least one outlet opening, through which soil, which penetrates into the pipe at the leading end thereof as driving proceeds, leaves the inside of the pipe.

2. Apparatus according to Claim 1 in which the intermediate component is tubular.

3. Apparatus according to Claim 1 or Claim 2, in which the intermediate component has the at least one outlet opening leading from the front end face of the component, which in operation is in the rear end of the pipe.

4. Apparatus according to any one of Claims 1 to 3, in which the intermediate component has an external part-conical surface which fits in the pipe at one end, an internal part-conical surface which receives the driving member at the other end, and the at least one outlet opening extends radially outwards between the part-conical surfaces.

5. Apparatus according to any one of Claims 1 to 4, further comprising means for supplying liquid to the front end of the pipe to wash soil entering the front end of the pipe through the pipe and out of the at least one outlet opening.

6. Apparatus according to Claim 5, in which the means for supplying liquid comprises a tubular driving shoe for fitting to the front end of the pipe, the shoe having liquid outlet openings and a liquid supply pipe, which in operation extends through the pipe being driven, connected to the shoe.

7. Apparatus according to Claim 6, in which the liquid outlet openings extend radially inwards from an annular duct which extends around the shoe.

8. Apparatus according to any one of the preceding Claims, in which the intermediate component includes a guide device for deflecting soil in the inside of the pipe radially outwards through the at least one outlet opening.

9. Apparatus according to Claim 1, substantially as described with reference to *Fig. 2* or *Fig. 3* of the accompanying drawings.

10. A method of driving an open-ended pipe through the ground using apparatus in accordance with any one of the preceding Claims, in which a tubular shoe is fitted to the front end of the pipe, the intermediate component is engaged with the rear end of the pipe, the driving member is engaged with the intermediate component and a driving force is applied to the driving member to drive the pipe through the ground, thus causing soil to enter the pipe through the shoe and, as driving continues, the soil entering the pipe passes through the pipe and out of the at least one outlet opening.

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